VOL. 31 No. 7

BULLETIN

OF THE

TORREY BOTANICAL CLUB

JULY, 1904

Chemical notes on "bastard" logwood *

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During the past few years the growers of logwood in Jamaica have been greatly disturbed by an apparent increase on their properties of an unmerchantable variety of the plant known as "bastard" logwood.† The exportation of this wood along with real logwood has served to condemn all the logwood from the districts which have shipped it.‡

"Bastard" logwood differs from the genuine varieties, from the dyer's standpoint, in yielding little or no hematoxylin, but, instead, a yellowish-green pigment which is of no value and which, when admixed with the commercial extract, reduces the characteristic tinctorial properties of the latter. Chips of the "bastard" logwood present a yellow, pale pink, white or even chocolate-colored surface instead of the dark red or deep purple, bronze-tinted color of the best Jamaican or Mexican logwoods of commerce. There appears to be considerable uncertainty, even when the trees are cut down, as to whether a tree is really a "mulatto" ("bastard") tree or not. What is known as a "mulatto" tree is frequently dark enough when first cut to lead one to believe that it is a good redwood tree, but instead of darkening with age as all the good wood does, it remains the same color or becomes lighter rather than darker. The "bastard" tree

* From the New York Botanical Garden, New York. Some of the chemical work was done in the laboratory of physiological chemistry of Columbia University.

† Fawcett: Bulletin of the Botanical Department, Jamaica, 3: 179. 1896.

‡ Clipping from a Kingston, Jamaica, newspaper, sent to Dr. D. T. MacDougal by Hon. William Fawcett (September, 1901).

[The preceding number of the BULLETIN, Vol. 31, No. 6, for June, 1904 (31: 309-366, *pl. 13, 14*) was issued 24 June, 1904.]

seems to be perfectly dry, and even when the chips are soaked for a long time in water, they give out no dye.*

Various theories have been advanced to explain the apparent increase in the "bastard" logwood in Jamaica. Professor F. S. Earle, after a thorough study of the situation in Jamaica, came to the following conclusions: †

1. "Logwood is a variable plant showing marked differences in form, color and texture of leaf; time of blooming; form and extent of ribs on the trunk; color of bark and especially in the color and dye-producing quality of the heart-wood. Four well-marked varieties are said to be recognized in Honduras and three are usually recognized in Jamaica, but there are many other intermediate forms."

2. "Bastard" wood is not the result of disease or of any lack of vigor. The trees producing it are perfectly healthy and normal.

3. "It is not the result of soil or climatic conditions, since 'bastard' and normal trees are found growing side by side under absolutely identical conditions."

4. "It is not the result of immaturity. Aged trees may produce 'bastard' wood, while in normal trees the heart-wood, as soon as formed, contains a good percentage of hematoxylin. These facts seem to point to heredity as the probable cause of the trouble. That is, that certain trees produce only 'bastard' wood because they grow from the seed of a 'bastard' tree; or in other words that 'bastard' logwood represents a variety of *Haematoxylon campechianum* that normally produces little or no hematoxylin, just as one Honduras variety has smaller, shorter, thinner and lighter colored leaves."

Some time before Professor Earle made his investigations in Jamaica we began, at Dr. MacDougal's suggestion, a comparative study of logwoods from that island, in the hope of finding definite chemical differences, other than purely tinctorial ones, between "red logwood" and the "bastard" variety. Unfortunately our work in collaboration was soon unavoidably interrupted. We present here very briefly, however, such of our notes in this connection as may be of general interest.

* Cradwick: Report to the Chairman of the Experiment Station, Kingston, Jamaica, 1902 (April 4).

† Earle: Journal of the New York Botanical Garden, 4: 3. 1903.

ELEMENTARY COMPOSITION OF HEART-WOOD. — Elementary analysis of typical samples of (1) the red logwood of commerce, (2) a "bastard" variety somewhat resembling it and (3) a second specimen of the "bastard" type yielding hardly any pigment to water gave the following results:

TABLE I.

PERCENTAGE ELEMENTARY COMPOSITION OF SUBSTANCE DRIED TO CONSTANT WEIGHT AT 110°C.*

	I. "Red" Logwood.			II. "Bastard" (medium grade).			III. "Bastard" (poorest quality).		
	C†	H	Ash.	C†	H	Ash.	C†	H	Ash.
1	51.91	5.98	1.80	51.45	5.83	1.59	51.04	5.67	2.03
2	52.00	5.80	2.06	51.77	6.03	1.68	51.35	5.74	1.86
3	52.12	5.76	1.71	51.45	6.03	—	51.00	5.58	—
Av.	**52.01**	**5.84**	**1.86**	**51.56**	**5.96**	**1.63**	**51.13**	**5.66**	**1.94**

SUMMARY OF AVERAGES.

	I.	II.	III.	General Average.
Carbon,	52.01	51.56	51.13	51.57
Hydrogen,	5.84	5.96	5.66	5.82
Ash,	1.86	1.63	1.94	1.81
Oxygen.‡	42.15	42.48	43.21	42.61

The most significant feature of these results is the decreasing amount of carbon in the "bastard" wood. The differences are too slight to warrant any emphasis, but are such as might be due to a lower percentage of hematoxylin, which is a pigment of high carbon (and low oxygen) content — $C_{16}H_{14}O_6$.

The data of the second series of analyses, given in TABLE II, show that the wood was not decomposed in the process of drying to constant weight at 110° C. (first series) and that, therefore, the previous results were not influenced by that procedure.

GENERAL COMPOSITION OF SEEDLINGS. — In TABLE III we present the results of some analyses of seedlings of "red" logwood

* Only heart-wood was employed in this work. This was converted into sawdust and only such portions as passed through a very fine sieve were taken for analysis. The methods of analysis were those which are now in general use.

† The figures for carbon and hydrogen are calculated (from the data of direct analysis), for *ash-free* substance.

‡ Calculated, by difference, for *ash-free* substance.

TABLE II.

PERCENTAGE ELEMENTARY COMPOSITION OF SUBSTANCE DRIED TO CONSTANT WEIGHT AT 20 C.°

	I.			II.		
	C	H	H_2O	C	H	H_2O
1	46.90	5.40	7.95	46.58	5.28	7.97
2	46.98	5.24	—	46.87	5.45	—
3	47.08	5.20	—	46.58	5.45	—
Average.	**46.99**	**5.28**	**7.95**	**46.68**	**5.39**	**7.97**

and of the "bastard" variety. The condition of the seedlings at the time of analysis is shown in FIGURE 1. The outward appearance of the two kinds of seedlings was practically the same. Likewise, the differences among the figures in our table for general chemical composition are too slight to warrant any other conclusion than that the seedling metabolism was, in general, essentially the same in both varieties. The analyses were made 12 months after seeds were planted.

TABLE III.

GENERAL COMPOSITION OF LOGWOOD SEEDLINGS.*

		Water.		Solids.					
				Total.		Organic.		Inorganic	
		Red.	Bastard.	Red.	Bastard.	Red.	Bastard.	Red.	Bastard
Leaves,	*a*	60.33 59.89	60.05	39.67 40.11	39.95	37.08 37.70	36.93	2.59 2.41	3.02
	b	56.27	51.22	43.73	48.78	41.08	45.94	2.65	2.84
	c	63.57	60.68	36.43	39.32	34.72	36.50	1.71	2.82
Upper stem,	*a*	43.77	38.34	56.23	61.66	54.40	58.29	1.83	3.37
	b	39.06	34.01	60.94	65.99	59 08	63.99	1.86	2.00
	c	43.68	45.89	56.32	54.11	54.61	52.50	1.71	1.61
Lower stem,	*a*	43.19	39.99	56.81	60.01	55.62	58.32	1.19	1.69
	b	36.83	32.97	63.17	67.03	61.63	65.24	1.54	1 79
	c	43.39	44.46	56.61	55.54	55.41	54.14	1.20	1.40
Roots,	*a*	67.93	61.66	32.07	38.34	30.52	35.39	1.55	2.95
	b	65.32	70.58	34.68	29.42	33.20	27.70	1.48	1.72
	c	——	49.17	——	50.83	——	46.87	——	3.96

* Analyses were made by the usual drying and incineration methods. The portions subjected to comparative analysis were approximately of the same morphological location in each variety. The most significant differences seem to be the slightly larger proportion of water in the "red" wood and the relatively greater quantity of solids, especially inorganic matter, in the "bastard" samples.

CONCLUSIONS FROM THE GENERAL ANALYTIC DATA. — All of the preceding analytic results make it evident that the chemical differences existing among these logwoods are quantitatively very slight. They also make it appear probable that the variations in the different samples of the wood are chiefly variations in the chemical

FIGURE 1. Seedlings of logwood, one year old. a, "red logwood." b, "bastard logwood." Both grown from seeds obtained from "Old Hope" plantation, Jamaica.

characteristics of the pigments themselves, which, as is well known, possess as a rule high tinctorial qualities even when they occur in only very small amounts. Our results in this connection would also indicate that there are no striking structural differences among these varieties of logwood. They suggest, likewise, that even

metabolic tendencies in these logwoods are essentially the same, varying only, perhaps, in the course of events which involve relatively slight quantities of pigment.*

TINCTORIAL DIFFERENCES. — The foregoing results having shown that the differences among these logwoods were chiefly if not solely tinctorial, we next endeavored to ascertain the extent of the pigmentary variations.

Our first experiments in this connection were efforts to determine the relative tinctorial intensity of extracts of different samples of heart-wood sawdust made with equal volumes of various solvents under similar conditions of temperature, shaking, etc., from the same quantities of material dried to constant weight at 110° C.† Among the samples were several inferior qualities of red wood from dead and decaying trees.

TABLE IV gives our first results in this connection. The figures in that table denote the relative positions in a series of ten extracts — 1 indicating weakest coloration, 2 the pigmentation of next higher intensity and so on to 10 showing the most decided tinctorial effect.

The shade of color varied with each extractant, as would be expected. The following observations were made in this connection, on the color of the series of extracts referred to in TABLE IV.

I. Water—slight yellowish-brown to deep reddish-brown.‡
II. 0.2 per cent. HCl—faint yellow to orange.
III. 2.0 per cent. HCl—faint yellow through reddish-brown to bright red.
IV. 0.01 per cent. KOH — chocolate coloration throughout.
V. 0.15 per cent. KOH — deep chocolate coloration throughout.
VI. 0.5 per cent. Na_2CO_3 — chocolate coloration throughout; less than in V, greater than in IV.
VII. Saturated borax solution — faint yellow to deep reddish-yellow.
VIII. Ether — faint yellow to orange.
IX. Absolute alcohol — faint yellow to red.
X. Acetone — faint yellow through greenish-yellow to yellowish-red.
XI. Acetic ether — faint yellow to deep reddish-yellow; brighter than in VII.

* These conclusions are in harmony with those drawn from other standpoints by Professor Earle (quoted on page 368). They were arrived at independently by us and were included in our report, in December, 1902, to the Botanical Society of America, before we were aware of Professor Earle's deductions. Science, II. 17: 338. 1903.

† Drying occurred rapidly and seemed to have no transforming effect on the dust. This fact was noted before in another connection (page 369).

‡ The coloration intensities are indicated progressively from 1 to 10 (see TABLE IV). Individual exceptions are not referred to.

XII. Chloroform — no color in some, faint yellow in others.
XIII. Benzol — no color in any.

TABLE IV.

RELATIVE PIGMENTATION OF VARIOUS KINDS OF LOGWOOD.

Extractant.	*A*	*B*	*C*	*D**	*E*	*F*	*G*	*H*	*I*	*J*
I. Water.	1	2	3	10	4	6	7	5	8	9
II. 0.2 % HCl.	1	2	5	7	6	3	4	10	9	8
III. 2.0 % HCl.	1	2	4	3	5	6	7	8	9	10
IV. 0.01 % KOH.	1	2	4	3	5	6	7	8	9	10
V. 0.15 % KOH.	2	4	1	3	5	7	6	8	9	10
VI. 0.5 % Na_2CO_3.	2	3	1	6	4	5	7	8	9	10
VIII. Ether.	1	2	5	4	8	7	9	6	3	10
IX. Absolute alcohol.	1	2	4	3	6	5	9	7	8	10
X. Acetone.	1	2	4	3	5	9	6	7	10	8
XI. Acetic ether.	1	2	3	4	6	7	5	9	8	10
Average.	1.2	2.3	3.4	4.6	5.4	6.1	6.7	7.6	8.2	9.5

A—"Bastard" (very poor). *B*—"Bastard" (very poor). *C*—Immature wood of varying tints. *D*—"Purple" (from tree on extremely poor marly bank; tree mature, but dead in nearly all parts, including the roots). *E*—Immature wood of varying tints. *F*—"Bastard" (medium grade). *G*—Red (tap root of nearly dead tree). *H*—Red (tree over ripe; wood bored by ants). *I*—Red (from roots of dead tree). *J*—Red (best grade).

More important, however, than the variations in the shades of color in the extracts was the fact, already noted, that the *sequence* of coloration intensity (in extracts made under like conditions in detail in each series) *varied* with each solvent (TABLE IV). This result not only shows that the colors of the woods are not due merely to different amounts of the same pigment but also proves that the pigmentary differences are caused either by varying proportions of at least two pigments, or by the same pigment radical in more than one chemical condition — in combinations, it may be of different solubilities and stoichiometric relationships, and of different dissociable tendencies.

Relative tinctorial differences and variations are further shown in the following sample data, which indicate the quantity of water in c.c. added to 10 c.c. of 0.5 % Na_2CO_3 extract (TABLE IV) in order to make the tinctorial intensity approximately the same throughout the series.†

* This sample contained several pigments. One of these was purplish and quite unlike any in the other samples. The pigment was especially soluble in water. It was not ordinary hematoxylin.

† Dilution of D with an equal volume of water furnished the basis of coloration for the comparative observations.

TABLE V.

Sample of Logwood.	Water Added.	Sample of Logwood.	Water Added.
A	3.5 c.c.	C	7.5 c.c.
B	3.5	D*	10.0
F	5.5	H	10.9
E	7.1	I	12.2
G	7.1	J	17.8

The letters correspond to those in TABLE IV.

The tinctorial sequence after the above dilution is different from what it was before dilution as may be seen from the following summary: †

TABLE VI.

	1	2	3	4	5	6	7	8	9	10
Before dilution (TABLE IV).	C	A	B	E	F	D	G	H	I	J
After dilution (TABLE V).	A	B	F	E	G	C	D	H	I	J

The above facts are in further harmony with the foregoing conclusions regarding cause of coloration effects and relative differences.

Dilute aqueous extracts of two samples of red logwood and of one medium grade "bastard" wood all showed a similar yellow color, by transmitted light. The shades of color did not differ noticeably except in degree. In stronger extracts of equal concentration the first two appeared more reddish.

Treatment with alkalies, volatile and non-volatile, turned the color of the red logwood extracts to a blood-red, passing into purple, whereas in the "bastard" extract the shade of yellow was merely deepened, passing into the dull brown color of faded oak leaves. Dilute and concentrated mineral acids turned the yellow of the dilute aqueous extracts of the red wood into a color ranging from orange to bright red. In the "bastard" extract no such change was perceptible.

These differences in the behavior of the two sets of aqueous extracts toward acids and alkalies correspond to the differences between the reactions exhibited toward the same reagents by a

* This color was of the same intensity as the rest, but not the same shade. See footnote, page 373.

† A similar change in sequence of tinctorial intensity after dilution was noted in other extracts, also.

freshly prepared solution of the commercial "extract of logwood," and a solution four weeks old that had faded to a straw-yellow.

The chemical alterations undergone by the aqueous solution of the commercial extract are accompanied by such a decided change in color and in chemical properties that from a comparative study of such extracts we expected to learn something definite regarding the actual differences between the pigments in the heart-wood of "red" logwood and in that of the bastard variety. We were unable, however, to do so.

Experiments were started to determine, if possible, the relations of light and of air to the discoloration of solutions of logwood extracts. In a few weeks all the preparations had been attacked by growths of *Penicillium*, *Rhizopus* and other fungi. After filtration the solutions showed no appreciable differences in shade or color. But on diluting these filtered solutions with two parts of water and eventually with eight parts, differences were readily observed.

The solutions which had been in the light showed no change in color, whereas those kept in the dark had become distinctly yellow. The extracts to which the air had free access manifested the greatest changes.

SOLID MATTER IN LOGWOOD EXTRACTS. — We desired to ascertain, in comparative determinations, the quantities of solid matter in aqueous extracts of the various logwoods under investigation. The absolute amount of solid substance in 100 c.c. of the extract was always small — less than 0.02 gram. In the drying process slight decomposition seemed to result and perfectly constant weights could be obtained only after a long time. Although the absolute changes in weight were only very small, the proportionate variations in quantities so slight were quite large. For these reasons no comparative observations were attempted in this connection. The use of very large volumes of extract, to reduce the comparative effects of the variations referred to, was impracticable.

The general question of the physiology or chemistry of pigment-formation in the heart-wood was not approached at all, nor were the histological characters of the varieties compared.

There can be no doubt that "bastard" logwood is, as Prof. Earle also concludes (see page 368) a distinct variety or subspecies

of *Haematoxylon campechianum*, notwithstanding the slight morphological differences that distinguish it from the "red logwood" and "blue logwood." The differences in the floral organs between

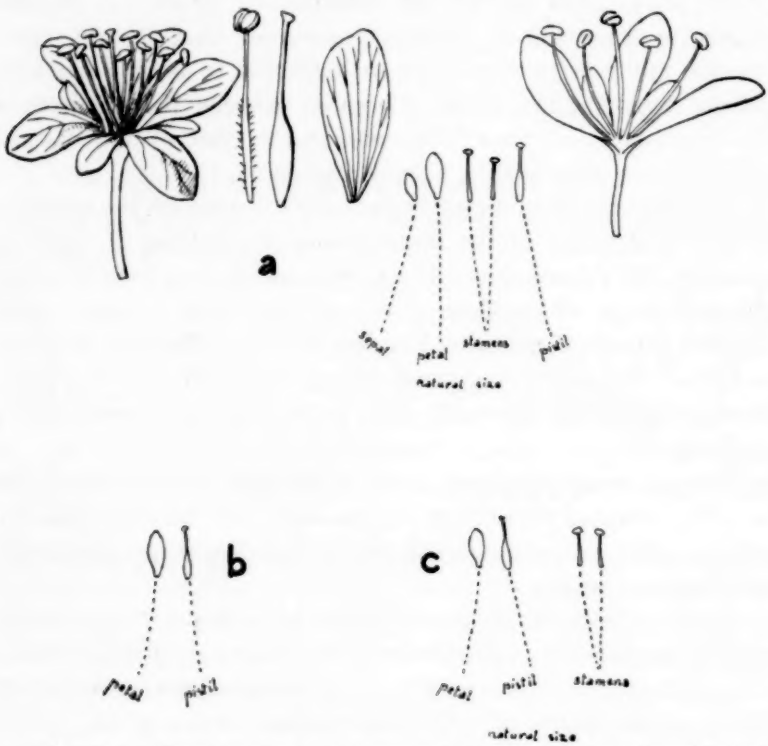

FIGURE 2. These drawings, which were made from specimens collected by Hon. William Fawcett near Morant Bay, Jamaica, show all the morphological differences that have been observed in the flowers of three varieties: *a*, "blue logwood." *b*, "red logwood." *c*, "bastard logwood."

The petals are widest in the blue and narrowest in the bastard.

The pistil of the blue is thicker than that in the red and the bastard. The style in the bastard is slightly curved.

In the bastard the stamens are smaller than in the others, and there is less difference between them.

It does not appear from the data at hand that the differences noted exceed the ordinary individual variations for the species of *Haematoxylon*.

the three varieties are shown in FIGURE 2, which was made from drawings sent by Mr. Fawcett, of the Jamaica Botanical Gardens.

That there are species which are not at all distinguishable from one another externally, but which vary in their physiological prop-

erties, is a recognized fact,* and the "bastard" logwood may simply be a new example of the same phenomenon. A parallel case would seem to be furnished by the black locust (*Robinia pseudacacia*), the wood of which is described by Sargent† as being "reddish, greenish-yellow or white, *according to locality*"; but the yellow and white varieties occur side by side in at least one locality.

SUMMARY.

1. The most significant fact shown by elementary analysis of the heartwood of typical specimens of logwood was the lower carbon content of the poorer wood, which may be due to lower pigment content, hematoxylin being a compound containing nearly twice as much carbon as oxygen.

2. No morphological differences are discernible between red logwood and bastard logwood in the young seedlings.

3. Analyses of the various seedlings agreed too closely to warrant any conclusion but that the metabolism of the seedlings was essentially alike in the two varieties.

4. The chemical differences between red logwood and "bastard" logwood are very slight, and are probably due to differences in amount of pigment.

5. Extractions with various solvents gave solutions of different colors, and also of varying orders of intensity in the several series, indicating the presence of at least two pigments in varying proportions, or a pigment radical in different combinations.

6. This was confirmed by the fact that the order of coloration intensity of a series of extracts was altered by diluting with water.

7. Aqueous extracts of the two varieties of logwood gave different reactions to acids, alkalies and other reagents. The differences are parallel to those between a fresh aqueous solution of commercial logwood "extract," and the same solution after it had become discolored on long standing.

8. Attempts to determine the conditions of the discolorations of solutions of commercial "extract," failed to yield definite results, but indicated, in general, that darkness and air are favorable to the change.

NEW YORK BOTANICAL GARDEN.

* DeVries: Mutationstheorie, 1: 122. 1901.

† Sargent: Catalogue of the forest trees of North America, 15. Washington, 1880.

Studies in Sisyrinchium — X. The species of California

Eugene P. Bicknell

The blue-eyed grasses of California, as shown by the collections which have passed under review in a study of the group, are common in many parts of the state and in nearly all parts are represented by one or more species, forming a noteworthy if not everywhere conspicuous element in the flora.

The widely diversified topographical features and sharply contrasted climatic conditions embraced within the great area of the state might well lead us to expect some striking reflection in so responsive a genus as *Sisyrinchium* occurring throughout, more especially since so many other sections of the United States have been found to possess a more or less characteristic group of species, and yet it has long been commonly supposed that scarcely more than a single species belonged to the California flora. In fact since Dr. Watson, in 1877, separated the most conspicuous California species from its eastern relatives under the name of *Sisyrinchium bellum* this name has been in common use for almost all specimens collected within the boundaries of the state.*

Within these boundaries, however, is an interesting group of species few of which appear to extend far beyond them. How many species make up this group cannot as yet be determined. Six or seven come out clearly enough from the mass of specimens which have been available for study, and others might be proposed on evidence perhaps sufficient yet not altogether convincing. For the present seven species are recognized. Of these *Sisyrinchium bellum*, the most conspicuous, appears also to be the most abundant. It proves, however, to be not at all of general distribution

* The yellow-flowered species formerly included in *Sisyrinchium* are here excluded from consideration, having already been separately treated under the revised genus *Hydastylus*. (Studies in *Sisyrinchium* — VIII. Bull. Torrey Club, **28**: 570–592. 1901.)

The even more distinct genus *Olsynium* of Rafinesque takes over another plant long accepted as a *Sisyrinchium*, the *Sisyrinchium grandiflorum* Douglas, as already pointed out. (Studies in *Sisyrinchium* — VII. Bull. Torrey Club, **27**: 237. 1900.)

throughout the state, being restricted, or very nearly so, to the coastwise counties, through which it ranges from San Diego, and doubtless Lower California, northward into Mendocino County, from beyond which no specimens have been forthcoming. This species bears the distinction of having flowers of larger maximum size than any other species of the United States, although surpassed in both the size and beauty of its flowers by *Sisyrinchium Macounii* of Vancouver Island.

In the Sierra Nevada region, northward from about the middle of the state, and beyond into Oregon, *Sisyrinchium bellum* is replaced by a slighter and smaller-flowered plant, *Sisyrinchium Greenei* sp. nov., which appears to be generally representative of that region, while in the valleys and mountains of the southern part of the state away from the coast another species, *Sisyrinchium Eastwoodiae* sp. nov., appears to be equally representative. A further, somewhat obscure species from the southwestern ranges nearer the coast is admitted as *Sisyrinchium hesperium* sp. nov. Four species appear from the extreme eastern parts of the state, one very distinct and apparently local species, *Sisyrinchium funereum* sp. nov., in the southeast, and three, *Sisyrinchium halophilum* Greene, *Sisyrinchium leptocaulon* Bicknell and *Sisyrinchium oreophilum* sp. nov., all simple-stemmed plants, mostly in the Sierra Nevada region.

SISYRINCHIUM HALOPHILUM Greene, Pitt. **4**: 34. 1899.

Inyo County, *Bishop;* Owen's Valley, alt. 5,000 ft., May 15, 1897, *M. E. Jones*, Herb. Missouri Bot. Gard. (not U. S. Nat. Herb., as cited in error Bull. Torrey Club, **26**: 451. 1899); Sierra Nevada Mts., 1875, *J. G. Lemmon*, U. S. Nat. Herb.

These specimens are stouter and broader-leaved, with thicker roots and perhaps larger flowers than the type, but are without perfect flowers and fruit and can be referred to no other species at present described.

The range of *S. halophilum* may be extended to Idaho, Wyoming and Colorado. From these states come a series of small, slender plants which, while contrasting markedly with the specimens from California cited above are brought closer to them by somewhat intermediate characters found in the Nevada type. The principal differences from the latter are more slender, less clustered roots, slenderly prolonged outer bract and apparently larger and darker-colored, thinner-walled capsules.

There seems, indeed, good reason to suspect the existence of a group of closely related simple-stemmed species inhabiting nearly the same general region, which on present material it is impossible to disentangle effectually from *S. halophilum* and *S. leptocaulon.*

SISYRINCHIUM LEPTOCAULON Bicknell, Bull. Torrey Club, **26**: 451. 1899.

Sierra Nevada Mts., near Lake Tahoe, *J. Ball*, July 20, 1884, Herb. Acad. Nat. Sci. Phila.

Tuolumne Co.: Soda Springs, Herb. Cal. Acad. Sci.

Lassen Co.: Milford, June 26, 1892, *T. S. Brandegee*, Herb. Cal. Acad. Sci.

The original description of *S. leptocaulon* was drawn from the specimen first above cited together with other material from Nevada and Utah less evidently distinct from *S. halophilum.* Of the additional specimens here recorded, that from Soda Springs, while clearly related to the Lake Tahoe type, shows a greater size for the species and a wider divergence from *S. halophilum* than has hitherto appeared. The stiff, narrowly margined stems are 45–70 cm. tall and about 1.5 mm. wide; the broadest leaves, nearly 2.5 mm. wide, are strongly rather few-nerved and more or less white-glaucous; the bracts are finely close-striate, the outer one stiffly short-pointed, scarcely surpassing the inner, and 2–2.5 cm. long; inner scales crowded, sometimes exceeding the shorter bract; pedicels close-fascicled, somewhat exserted; capsules pale, thick-walled, finely rugulose, 2.5–5 mm. high; seeds 2–3 in a row; a mature seed is nearly 2 mm. in diameter, irregularly compressed-subglobose and very minutely rugulose.

It is impossible to derive a clear understanding of either this species or *S. halophilum* from the scant material so far collected. While extreme examples of each appear obviously distinct, their relationship is confused by certain specimens which cannot be satisfactorily assigned at the present time. As already intimated there is good reason to believe that more than two species enter into the problem.

Sisyrinchium oreophilum sp. nov.

Stems simple, or occasionally developing a single terminal peduncle with subtending leaf, 10–25 cm. high from slender fibrillose roots; pale glaucescent green, showing some discoloration when dry. Leaves about half the height of the stems, firmly

erect, becoming rather strongly nerved, 1–3 mm. wide, tapering-acute, the edges smooth; stems .75–1.50 mm. wide, narrowly wing-margined, finely cartilaginous-denticulate to smooth; spathes narrow, the bracts rather prominently but not very closely fine-nerved, the hyaline edges narrow; outer bract 1.5–4 cm. long, narrowly attenuate, abruptly pointed or often obtuse, usually surpassing the inner one 2–10 mm., but sometimes longer, rather closely united-clasping for 5–7 mm. and with sharply keeled edges; inner bract usually abruptly scarious-obtuse and bluntly apiculate; inner scales little more than half the length of the bracts; pedicels erect, slightly exserted, often reddish-purple; flowers violet-purple; perianth 8–10 mm. long, the segments mucronulate-aristulate, slightly if at all emarginate; stamineal column 5 mm. long or less; anthers small, about 1 mm. long; ovary oblong, puberulent; capsule sparsely puberulent, brown, thin-walled, globose or obovoid, 2.5–5 mm. high, many seeded.

Mariposa County: Yosemite Valley, May–June, 1900, *F. T. Bioletti*, Herb. Cal. Acad. Sci. (type); Yosemite Valley and Mountains, *J. Torrey*, 1865, Herb. Columbia Univ.; Sierra Nevada Mountains, 8,000 ft., south fork of San Joaquin River, July, 1900, *H. M. Hall & H. P. Chandler, no. 652*.

Placer County: Downer Lake, July 25, 1895, *Edward L. Greene*, Herb. E. L. G.

Modoc County: 1894, *M. S. Baker and Frank Nutting*, Herb. E. L. G.

Appearing nearer to *S. angustifolium* than any species seen from west of the Rocky Mountain region, and variously suggestive, as well, of some of the simple-stemmed western species, but showing material differences from each one. It is a smaller plant than *S. angustifolium* with less unequal and more obtuse bracts of somewhat different nervation, smaller flowers with small anthers and more glandular-puberulent ovary, the capsules also more or less sparsely puberulent.

In the relative length of the bracts this species nearly agrees with *S. occidentale*, but it differs notably in much smaller flowers, less acute and differently shaped bracts, especially the narrower inner one, weaker and less narrowly margined, mostly rough-edged stems and more slender roots.

S. segetum is also much larger flowered, as well as taller and more slender, more densely tufted, narrower leaved and with slenderly very acute bracts.

S. halophilum and *S. leptocaulon* both differ essentially from *S. oreophilum* by their thicker roots and smaller, thicker-walled, pale capsules.

The only other simple-stemmed species of any of the Pacific states, *S. idahoense* and *S. sarmentosum*, need no comparison with *S. oreophilum*, the former being a much larger plant in every way, and the latter differing conspicuously by its narrowly prolonged foliaceous bracts, besides narrower and weaker leaves and stems and smaller flowers.

Sisyrinchium Greenei sp. nov.

Mostly 25–45 cm. high, from fibrous, sometimes slightly thickened roots, pale or glaucescent green, often darkening or becoming brownish in drying. Leaves commonly about half the height of the plant and 1–3 mm. wide, sometimes rather thin and soft or becoming firm, varying from linear-attenuate and straight to acuminate and somewhat curved, narrowly acute, the delicate nerves approximate, or becoming well separated on the broader leaves, the edges smooth; stems commonly terminated by one or two, or even three, slender but mostly short peduncles subtended by a usually shorter erect bractal leaf, sometimes bearing a leaf and axillary peduncle lower down, casually simple with terminal spathe, 1–3 mm. wide, narrowly thin-margined or winged, the edges smooth or obscurely denticulate near the node; peduncles 3–10 cm. long, often extremely slender, slightly diverging and mostly a little unequal; spathes often purplish, usually narrow, 15–20 mm. long, the bracts rather firmly fine-nerved, equal, or either one slightly the longer, the outer one mostly acute, sometimes slightly foliaceous and becoming 2.5 cm. long, united-clasping below for .05–.07 mm., the inner one often scarious, obtuse; inner scales mostly about three-fourths the length of the bracts; flowers on slender, slightly exserted pedicels, delicate, pale violet-blue, about 10 mm. long, the segments short-aristulate; stamineal column 5–6 mm. long; ovary glandular-puberulent; capsule subglobose or obovoid, brown, firm-walled, 3–7 mm. high; seeds numerous, apparently medium-sized.

Sierra Nevada Mountains from about midway in the state northward, extending into Oregon, ascending to at least 6,000 feet. Flowering mostly in June and July, although beginning to bloom in May, or even earlier, at lower altitudes. Named in honor of Professor Edward L. Greene.

Siskiyou County: North side of Mount Shasta, 5–9000 feet, June 11–16, 1897, *H. E. Brown, no. 351* (type).

Modoc County: June 14, 1893, *M. S. Baker.*

Plumas County: Near Pratville, Mountain Meadow, 5,500 ft., July 2, 1897, *M. E. Jones;* July, 1896, 1897, 1898, *Mrs. R. M. Austin.*

Butte County: Little Chico Creek, May, 1896, Colby, July, 1896, *Mrs. R. M. Austin.*

Placer County: Applegate, May, 1899, *Mrs. Helen Smith.*

An inhabitant of the mountainous region of the north and northeastern part of the state, there replacing *S. bellum* of the coastwise counties and ascending to high altitudes.

It is ordinarily a smaller, more delicate plant than *S. bellum*, paler green in color and drying paler, and with much smaller flowers. So considerable, however, are the variations shown by the series of specimens at present necessary to refer to this species that little doubt need be entertained that more than one species is involved. Confident segregation, however, must await critical study of more complete material.

The type of *S. Greenei* may be taken as H. E. Brown's *no. 351*, from Mt. Shasta, of which I have seen four good sheets from as many herbaria and which is somewhat intermediate between extremes of the series.

Certain specimens from high elevations in Plumas County, as well as from Klamath Lake, Oregon (July, 1893, *Mrs. R. M. Austin*), are extremely delicate and slender throughout and bear only one or two terminal peduncles; other specimens are considerably stouter with broader and thinner leaves. A few specimens vary suggestively from the type by unusually long peduncles, broad thin leaves and sharply serrulate stems, and appear also to be earlier-flowering, several specimens having been collected in full flower in the month of May.

A particularly notable specimen more than doubtfully associated with the others here assigned is from near Pentz, Butte Co., collected by *Mrs. C. C. Bruce*, April, 1897 (Herb. Cal. Acad. Sci.), in full flower and with some mature fruit, although typical *S. Greenei* appears not to bloom ordinarily until June and July; these specimens are further remarkable for their greatly elongated stems and leaves, some being 70 cm. high, very pale and glaucous, peduncles in clusters of 2–5, and capsules very large, becoming 7 mm. high.

Sisyrinchium Eastwoodiae sp. nov.

Glaucescent green, often brownish-tinged on the herbarium sheet, 20–60 cm. high; roots clustered, becoming slightly thickened towards the base. Leaves firm, with acute hardened tips, sometimes nearly equalling the stem but more often half its height, 1–3 mm. or even 4 mm. wide, firmly striate-nerved, the edges smooth or, in forms, roughened with minute points; stems erect, often flexuously curved, about the width of the leaves, flattened and narrowly winged to subterete and merely margined, the edges smooth or, in forms, bearing close-set, erect or retrorse cartilaginous points; node mostly one, high up, or sometimes two, its leaf shorter than the peduncles, often very short, stiff and bract-like; peduncles one to four, mostly short but sometimes very slender, 3–10 cm. long; spathes narrow, flattened, 1.3–2 cm. long, the bracts finely, but not very closely striate-nerved, the inner one commonly the longer and acuminate or apiculate from a scarious apex, the outer one cuspidate or stiffened to a short corneous tip, united-clasping for 4–8 mm. at base; inner scales equaling the shorter bract or sometimes much shorter; flowers rather numerous, 8–14, on erect or slightly spreading exserted pedicels, rather small; perianth 8–12mm. long, the segments broadly short-aristulate from a usually slightly retuse apex, violet-purple, the yellow eye small; stamineal column about 5 mm. long, ovary loosely glandular puberulent; capsule pale or dark brown, subglobose to obovoid or pyriform, thick-walled, sparsely puberulent, small, 2–4 mm. high; seeds 1–4 in each row, about 1.5 mm. in diameter, rugulose.

Valleys and mountains of Southern California extending into Lower California, not apparently reaching the coast; blooms from early May to July or later. Named in honor of Miss Alice Eastwood.

Kern County: Tehachapi, June 22, 1889, *Prof. E. L. Greene;* San Emidio Cañon, October 2, 1894, *Miss Alice Eastwood.*

San Bernardino County: San Bernardino Valley, in meadows. May, 1886, *S. B. & W. F. Parish, no. 663* (type), also 1889 and 1888, by same collectors; San Bernardino, May 3, 1898, *S. B. Parish,* 1880, *G. R. Vasey;* San Bernardino Mountains and their eastern base, alt. 5,000 ft., June 28, 1894, *S. B. Parish, no. 3045.*

San Diego County: San Ysabel, May, 1893, *H. W. Henshaw;* Cuiamaca Mountains, July 12, 1875, *Edward Palmer, no. 374.*

The above description of *S. Eastwoodiae* has been derived primarily from the plant of the San Bernardino Valley represented

mainly by the collections of S. B. and W. F. Parish. This is, apparently, the largest form of the species, frequently developing two leaf-bearing nodes, and with the basal leaves mostly about half the height of the close tufts, becoming even more than 4 mm. wide. This plant shows more or less discoloration on the herbarium sheet. It comes into flower in April and May.

Specimens collected by Professor Greene at Tehachapi, still flowering towards the end of June, are tall, pale in color, with long, slender, narrowly attenuate leaves and somewhat flexuous, very firm, smooth-edged stems with a single node and slender peduncle; the bracts of the spathe are narrow and firm, the shorter primary one with a stiff corneous tip.

Near this form may be placed a small, very different-appearing plant collected by Miss Alice Eastwood in San Emidio Cañon, Kern County, still flowering in October. Its leaves are short, especially the nodal leaf, the stems and peduncles very slender, the bracts mostly under 1.5 cm. in length, and the capsules only 2–2.5 mm. high; the outer bract shows the same hardened nail-like tip seen in the Tehachapi specimens.

In the absence of further material for study there may be referred here, also, Dr. Edward Palmer's *no. 374*, collected on mountains in the southern part of San Diego County in full flower, July 12th. These specimens are noteworthy in several ways, especially by reason of the harshly cartilaginous-ciliolate edges of leaf and stem and the roots which are distinctly woody-thickened toward the base; the bracts also appear to be more membranous than in the more northern plant and are mostly very acute, but without an indurated tip.

Another collection from the San Bernardino mountains must for the present find its place here also, although presenting many points of contrast. The stems are but 6–15 cm. high, many of them simple but others bearing two short peduncles; the leaves are short, relatively broad and mainly obtuse as are the broad short bracts, and both stems and leaves are more or less denticulate or even cartilaginous-ciliolate. This plant was collected by S. B. Parish in flower, June 28th, at an altitude of 5,000 ft., and though strikingly at variance with the valley plant may well be a modified sub-alpine form.

Sisyrinchium funereum sp. nov.

Stiff and erect in scant tufts becoming 50–60 cm. high, pale glaucous-green, not discoloring when dry, the dead leaves and stems of the previous season, bleached to a light straw-color, persisting rigidly amid the fresh growth; roots soft and stout, mostly 2–3 mm. thick towards the base when dried and becoming over 30 cm. long. Leaves somewhat shorter than the stems, very smooth throughout, strongly close-nerved, 2–3.5 mm. wide, narrowly tapering to an acute, hard-pointed apex, their bases broadened and equitant; stems 2–4.5 mm. wide, stiff and straight, narrowly firm-margined and very smooth; node only one, high up, bearing a stiff, erect bracteal leaf 4–10 cm. long, subtending 2–3 longer approximate peduncles; peduncles slender, erect, straight or slightly curved, unequal, 4–12 cm. long; spathes erect or slightly bent, 18–23 mm. long, 2–3 mm. wide; bracts closely approximate, firmly close-nerved, the inner one usually slightly surpassing the outer, its tip white-scarious, obtuse, or even truncate or emarginate and apiculate, sometimes erose-denticulate; outer bract hyaline-margined nearly to the short-pointed apex, broadly so below, united-clasping for 5–7 mm.; inner scales crowded, silvery white, about equaling the bracts in length; flowers numerous, finally 12–18, on slightly exserted puberulent pedicels; perianth-segments violet-blue, 12–14 mm. long, contracted to a mucronate apex; stamineal column about 5.5 mm. high; ovary densely glandular-puberulent; pedicels fascicled, stiff and erect, or somewhat diverging above, the weaker ones sometimes spirally flexuous; capsules light-colored, thick-walled, 3–6 mm. high, oblong-ovoid to broadly ovoid, often truncately contracted above and below, more or less distinctly moulded over the seeds; seeds rather few, 2–4 in a row on slender stipels from central placentae, mostly globose and 1.5 mm. in diameter, black, rugulose, reticulate, not umbilicate.

Furnace creek cañon, Funeral Mountains, January 27, 1891, *Frederick V. Coville & Frederick Funston*, Death Valley Expedition of the U. S. Department of Agriculture, *no. 225*.

A striking species, tall and stiff and very pale in color, with appressed peduncles, rather large flowers and greatly developed root-system. The persistence from one flowering season to another of the dried and rigidly erect leaves and stems is a noteworthy characteristic of the plant. It would appear from the single collection of the species so far made that the seeds of one season were carried over to the succeeding one to be released when the plant came again into flower.

SISYRINCHIUM BELLUM S. Watson, Proc. Am. Acad. **12**: 277. 1877.

Remarkably variable in size and relative proportions; from 6 cm. to over 6 dm. high, mostly 2.5–4 dm., green to glaucescent, subject to slight or to pronounced discoloration on the herbarium sheet, the tufts often fibrillose at base, the roots either slender or somewhat thickened, frequently from an ascending or horizontal, sometimes compound, woody rootstock. Leaves soft and rather thin, or becoming firm, finely many-nerved, sometimes equaling the plant in height but usually shorter, mostly 2–4 mm. wide (1–6 mm.), acute or aculeate, the edges smooth or denticulate; stems erect, stout or slender, 1–4 mm. wide, narrowly firm-margined to narrowly winged, the edges smooth or denticulate; sides of leaves, bracts and stems rarely obscurely roughened with harsh points; primary node supporting from 2–4 peduncles or one or two branches each with 1–2 peduncle-bearing nodes; primary stem-leaf conspicuous, the bracteal leaves usually much reduced; peduncles stout or very slender, straight or curved, divergent or erect, sometimes very short but becoming 18 cm. long; spathes very variable, linear, lanceolate, or short oblong, 1.5–6 mm. wide when pressed, the bracts green or purplish, very acute to obtuse, straight to strongly incurved, subequal or very unequal, when subequal 1.5–3 cm. long, when very unequal foliaceous and reaching a length of 3.5 cm. for the inner and 5.5 cm. for the outer bract; bracts finely many-nerved, the edges often conspicuously white or purplish margined, the outer one united-clasping below for from ¼ to ½ its length; inner scales mostly brownish tinged, sometimes equaling the bracts, but usually much shorter; flowers on slightly or slenderly exserted erect or diverging pedicels, varying in color from blue and violet to lilac, in light and dark shades, in one specimen pure white; segments sharply emarginate or contracted to the mucronate or aristulate apex, 12–20 mm. long; column 5–7 mm. high; ovary glandular-puberulent to glabrous; capsules dark or pale brown, depressed-globose to obovoid or pyriform, in some forms strongly trilobulate, 2–7 mm. long; seeds 1 or 2 to 5–6 in each row, about 1.5 mm. in diameter, dark, pitted, subglobose.

Apparently common in all the coastwise counties from San Diego to Mendocino, extending from the immediate coast back into the mountains, but no evidence has developed of its occurrence in any of the inland counties.

In the southern part of the state the species begins to flower in February and March, and sometimes even in March in the neighborhood of San Francisco. At its northern limit flowering begins in May and June, continuing into July and August.

San Diego County: San Diego, 1850, *C. C. Parry;* May, 1852, *Geo. Thurber;* April, 1866, *Weed;* 1882, *C. G. Pringle;* 1884, *C. R. Orcutt;* 1885, *E. L. Greene;* February 19, 1891, *Alice Eastwood;* Delmar, April 16, 1895, *Belle S. Angier;* Fall Brook, March 17, 1882, *Marcus E. Jones.*

Los Angeles County: Los Angeles, April, 1888, *Dr. H. E. Hasse;* March 14, 1890, *Fritchley;* San Gabriel, March 23, 1854, *Dr. J. M. Bigelow.*

Santa Barbara County: Santa Barbara, 1874, *Miss S. P. Monks.*

Monterey County: Santa Lucia Mountains, August, 1885, *T. S. Brandegee;* April, 1898, and May 20, 1897, *R. A. Plaskett.*

Santa Cruz County: *Horace Davis.*

San Mateo County: Purisima, April, 1898, Blenheim, May 19, 1901, *Alice Eastwood.*

Alameda County: Salinas Plains, March, 1866, *A. Wood;* Berkeley, 1882, 1886, *E. L. Greene;* 1892, *Michener & Bioletti;* Point Isabel, June, 1900, *Alice Eastwood.*

San Francisco County: near San Francisco, *Dr. A. Kellogg,* 1866; March, 1892, *Michener & Bioletti;* May, 1894, *Alice Eastwood.*

Marin County: April, 1895, *Alice Eastwood.*

Solano County: 1866, *A. Wood;* Bernicia, *Rev. J. P. Moore.*

Sonoma County: *E. Samuels;* Bodega Point, July 4, 1900, Hood Mountain, April 27, 1893, Altruria, April 7, 1900, *Alice Eastwood.*

Mendocino County: Long Valley, 1871; May, 1898, June, 1898, *H. E. Brown;* Red Mountain, Strong Mountain, May 21–28, 1902, Fort Bragg, August 9, 1902, *Alice Eastwood.*

Although no specific type of *Sisyrinchium bellum* is cited by Dr. Watson, a number of sheets labeled by his hand are preserved in the Gray Herbarium. Among these are excellent examples of the stout and large-flowered coastwise plant which Dr. Watson's description furthur unmistakably defines. There need be no doubt, therefore, as to the right application of the name *Sisyrinchium bellum,* notwithstanding the existence of several sheets so labelled by Dr. Watson, which, as it now appears, really represent other species.

Even as here delimited, however, *S. bellum* is still quite cer-

tainly an aggregate, and certain further lines of subdivision not yet clearly shown may confidently be expected to reveal themselves to careful field observation and the study of ample material.

In the more southern coastwise counties of the state occurs a form commonly more tufted, smaller and more branched than the type, often more fibrillose about the base and usually turning much darker on the herbarium sheet; other comparative differences appear in very slender erect peduncles, smaller spathes with subequal often sharply apiculate or aculeate bracts, smaller flowers and small, dark, trilobulate capsules only 2–4 mm. high.

In marked contrast with this is another form apparently confined also to the southern coastwise counties which discolors less when dry and is tall and stout, with rather short, curved peduncles, short, oval spathes with mostly equal, often obtuse bracts, and apparently larger flowers with broader less slenderly aristulate segments.

Similar to the type, but usually lower and less branched and with shorter peduncles, is a form apparently best developed somewhat northward in the range of the species which is noteworthy for its conspicuously foliaceous and often greatly elongated unequal bracts; in this plant the ovary is sometimes, at least, quite glabrous.

Also from northward in the range of the species, especially from Mendocino County, come a few specimens very slender throughout having mostly two slender approximate peduncles, narrow, very acute bracts, much exserted pedicels, the flowers with narrow segments, and small, subglobose, few-seeded capsules.

Still further rather suggestive indications of other species are afforded by certain imperfect or fragmentary specimens of little use to discuss at the present time.

Sisyrinchium hesperium sp. nov.

Slender, erect or ascending in thin, somewhat open tufts sparsely fibrillose at base, 25–40 cm. high, dull green and glaucescent becoming brownish in drying, the slender roots numerous and densely clustered. Leaves thin and soft or becoming firm, half the height of the stem or less, 1–3 mm. or even 4 mm. wide, usually narrowed towards the base, tapering-acute, straight or slightly falcate, the edges smooth or obscurely denticulate-roughened; stems fragile, 1–2.5 mm. wide, merely margined, or with

narrow finely nerved wings, the edges smooth or slightly denticulate; peduncles 1–3, erect or diverging, long and very slender, 5–14 cm. in length; spathes narrow, 15–25 mm. long or the outer bract longer; bracts membranous, narrow, often attenuate, delicately nerved, mostly cuspidate-acute and often narrowly aristulate, distinctly white-margined, the outer one united-clasping below for 5–10 mm., sometimes for half its length; inner scales narrow, attenuate, about three-quarters the length of the bracts; flowers on hair-like exserted pedicels, deep violet-purple, perianth about 10 mm. long; stamineal column about 5 mm. long; capsules often on flexuously spreading pedicels, brown, thin-walled, obovoid-pyriform to subglobose, 3–5 mm. high, slightly puberulent; seeds only 2–4 in each row, large, becoming 1.5 mm. or more in diameter, rugulose.

Near the boundary between Santa Barbara and San Luis Obispo Counties, Dutard's Ranch, May 9, 1896 (type).

Fresno County: Wauthan, May 11, 1893.

Monterey County: Melpitas Ranch, Santa Lucia Mountains, May 1–12, 1899.

All in flower and early fruit and collected by *Miss Alice Eastwood.* In Herb. Cal. Acad. Sci.

A much more slender and delicate species than *S. bellum*, often very fragile, with long, very slender peduncles, smaller, more delicate flowers on hairlike, mostly flexuously exserted pedicels, and smaller, thinner-walled capsules.

Notes on Micrasterias from southeastern Massachusetts

JOSEPH A. CUSHMAN

During the spring and summer of 1903 a number of collections of desmid material were made in various localities of southeastern Massachusetts by the writer. Some of these were exceedingly rich in desmids. As no results of examinations of the desmid flora of this part of the state have ever been published except in a previous short paper by the writer (Desmids of Bridgewater, Mass. Rhodora, **5**: 79–81. Mr 1903) a comparison of the forms found in this area with those reported from other parts of New England may be instructive. The nomenclature as previously used in connection with New England species in many cases needs correcting. As many of the forms found are apparently new, they may best be presented by single genera or groups of genera to allow more ease in working them up. The New England desmid flora is as yet hardly touched upon, and what may be expected in the line of new forms may be seen by a single paper of Lagerheim's on a collection from Tewksbury, Mass., where many new species and varieties were described.

As one would expect from the characters of the genus taken up in the present paper—*Micrasterias*—it has been better worked up than many of the others. The species are of large size and usually very distinct — at least in those found in New England. One thing was apparent in looking over the data obtained — this genus appears to be almost wholly confined to ponds and lakes. Naturally, some are found in the streams, but, as far as can be noted from New England data, not of many species in a locality nor of many individuals. In the case of ponds and lakes the opposite is usually true: there are many species present and usually an abundance of specimens. Of twenty-five collections representing eleven localities, but four had *Micrasterias* represented by more than one species in any abundance. These were all from ponds or lakes. Mr. G. E. Stone, in his list of the desmids of Lake Quinsigamond, near Worcester, Mass., gives twenty-three

species and varieties, considerably more than half of those reported from the whole of New England. The following species were found in the collections made in 1903.

MICRASTERIAS RADIOSA Ag.

A typical form of this species was common in Carver's Pond, Bridgewater, but was not noted in any other of the collections. An average specimen measures long. 186 μ, lat. 207 μ, lat. isth. 22 μ, lat. lob. pol. 34 μ.

M. RADIOSA **Wollei** var. nov.

Found at Chilmark, Martha's Vineyard. This variety is that figured by Wolle (Desmids of the U. S. ed. 2. 1892) on *plate 35, figure 3*. It is not as wide as the typical form and is much smaller, with a row of minute granules bordering the edge of the sinuses, not quite as open as the specimen figured by Wolle. In some respects this variety tends toward *M. papillifera*. An average specimen measures long. 152 μ, lat. 146 μ, lat. lob. pol. 28 μ.

M. DENTICULATA Bréb.

Found both in Carver's Pond, Bridgewater, and at Lake Watuppa, Fall River. An average specimen measures long. 234 μ, lat. 195 μ, lat. lob. pol. 72 μ, lat. isth. 25 μ.

M. APICULATA FIMBRIATA (Ralfs) Nordst.

The form described by Ralfs in 1848 as *M. fimbriata* is considered by Nordstedt as a subspecies of *apiculata* published by Ehrenberg several years earlier. Nordstedt includes under this subspecies the forms called by Wolle var. *apiculata*, var. *elephanta*, and var. *nuda* as well as *M. simplex* Wolle of the first edition, 1884, which Wolle called *M. fimbriata* var. *simplex* in the second edition, 1892.

This form was found both in Carver's Pond and Lake Watuppa. Two specimens from the first locality were measured, the first, long. 186 μ, lat. 180 μ, lat. isth. 38 μ, lat. lob. pol. 40 μ; the second, long, 229 μ, lat. 205 μ, lat. lob. pol. 50 μ.

M. FURCATA Ag.

Found both in Carver's Pond and in Lake Watuppa. A specimen from the latter locality measures long. 180 μ, lat. 160 μ, lat. isth. 30 μ, lat. lob. pol. s. proc. 22 μ. The variability of this spe-

cies is very great, but according to W. and G. S. West this variability is limited to American specimens.

M. AMERICANA (Ehrb.) Ralfs.

The typical form was obtained from a pond at Plainville and also from Carver's Pond, Bridgewater. An average specimen from Plainville measured long. 155 μ, lat. 130 μ, lat. lob. pol. c. proc. 54 μ, lat. isth. 28 μ. One from Bridgewater, long. 158 μ, lat. 133 μ, lat. isth. 22 μ, lat. lob. pol. c. proc. 50 μ.

M. AMERICANA RECTA Wolle.

This variety was noted from Carver's Pond, Bridgewater, but measurements were not obtained.

M. AMERICANA **spinulifera** var. nov.

End lobe short and in general appearance much like var. *Ralfsii* Maskell. Not as spinose as var. *spinosa* Turner and without the "spinose coronet" of that form. Considerably smaller than the typical form and slightly smaller than the var. *spinosa*. Ends of the lobes spinose, also two subcentral spines at the basal margins. Long. 120 μ, lat. 108 μ, lat. isth. 25 μ, lat. lob. pol. c. proc. 57 μ, lat. lob. pol. s. proc. 33 μ. From Stub Pond, three miles northeast of Fall River R. R. Station.

M. LATICEPS forma MAJOR Nordst.

Found both in Carver's Pond and in Lake Watuppa. A specimen from the latter measured long. 150 μ, lat. 165 μ, lat. isth. 37 μ.

M. MAHABULESHWARENSIS COMPACTA, a. AMERICANA Nordst.

Noted from Carver's Pond, Bridgewater in the previous list.

M. TRUNCATA (Corda) Bréb.

The typical form was found in a pond at Chilmark, Martha's Vineyard and in Lake Watuppa. A specimen from the former locality measured long. 113 μ, lat. 110 μ, lat. lob. pol. 81 μ. A Watuppa specimen, long. 100 μ, lat. 93 μ, lat. lob. pol. 55 μ, lat. isth. 19 μ. Although this species is supposed to be very common it was found in but these two localities.

M. DEPAUPERATA Nordst.

The typical species, FIGURE 1, was described by Nordstedt from Brazil, the measurements of the original, as given by the au-

thor, being long. 84–96 μ, lat. 64–78 μ, lat. lob. pol. 48–59 μ, crass. 23 μ.

As noted by Lagerheim, *M. Kitchelii* Wolle is a form of this species. There seem to be two distinct American forms besides the typical form of Nordstedt. They may be separated as follows:

M. DEPAUPERATA KITCHELII Wolle. FIGURE 2.

This name, as suggested by W. and G. S. West, should be retained for the form figured by Wolle (Desm. U. S. *pl. 37, f. 1, 2.* 1884), with the shorter and considerably wider polar lobe. It is much larger than the previous form.

M. DEPAUPERATA **Wollei** var. nov. FIGURE 3.

This name is proposed for the variety figured by Wolle as *M. Kitchelii* var. (Desm. U. S. ed. 2. *pl. 42. f. 2.* 1892) and by W. and G. S. West as *M. depauperata* Nordst. (Trans. Linn. Soc. Lond. II. Bot. **5**: *pl. 14. f. 1*). This is nearer the typical form but is one-half larger, the sinus more open, the apical lobe shorter and the upper portion of the basal lobes considerably narrower than the lower. A typical specimen measures long. 150 μ, lat. 140 μ, lat. lob. pol. 96 μ, lat. isth. 26 μ. Very common in Lake Watuppa.

M. MURICATA (Bailey) Ralfs.

This species was found in but one locality, Carver's Pond, Bridgewater. An average specimen measured long. 161 μ, lat. 127 μ, lat. isth. 31 μ, lat. lob. pol. 78 μ. In the Trans. Linn. Soc. Lond. II. Bot. **5**: 240, *pl. 14, f. 7*, W. and G. S. West give the varietal name *tumida* to a form which "differs from the typical form in having a central protuberance near the base of each semicell." Which should be considered the typical form is somewhat doubtful. In Bailey's original figures a side view and an oblique view are given. In looking over his original drawings and notes several end views were found. Three out of four of these had the basal protuberance, in two cases even more marked than in the

figure given by W. and G. S. West. It was a custom of Bailey's to mark the drawing he considered as typical to distinguish it from the rest. This he did by writing the word "standard" close to the particular drawing. In this case it is found with a specimen of the basal view with very decided prominences. It would therefore seem that the original specimens possessed by Bailey and from which he wrote his description were of the form called above var. *tumida* by W. and G. S. West. As this character is very variable in any lot of specimens and as the typical specimens seem to have had this character the value of the varietal name *tumida* is somewhat in doubt.

BOSTON SOCIETY OF NATURAL HISTORY.

Studies on the Rocky Mountain flora — XI.

PER AXEL RYDBERG

Juncus balticus vallicola var. nov.

Stem from a horizontal rootstock, rather stout, 6–8 dm. high, terete, 2–4 mm. in diameter; sheaths at the base short, dark brown, bladeless; bract 1–2 dm. long; bractlets broadly ovate, scarious, brown, abruptly acuminate; inflorescence open; its branches 4–8 cm. long; sepals narrowly lanceolate, slightly if at all scarious on the margin, attenuate at the apex, about 6 mm. long; petals much broader and shorter with broad scarious margin, about 5 mm. long; anthers about 4 times as long as the filaments; capsules short ovoid, obtusish and mucronate, shorter than the petals.

This variety has the open inflorescence and general habit of var. *litoralis* but the fruit of var. *montanus*. It differs from both, however, in the long-attenuate sepals. It grows in wet ground, both in alkaline and sandy or gravelly soil in the valleys of the Rocky Mountain region.

WYOMING: Point of Rocks, 1901, *E. D. Merrill & E. N. Wilcox, 664* (type)*; Big Sandy River, *730*; Steamboat Mountain, 1900, *Aven Nelson, 7075*.

COLORADO: Mancos, 1898, *Baker, Earle & Tracy, 438*.

UTAH: Antilope Island, *Stansbury*.

Juncus truncatus sp. nov.

J. alpinus insignis Coult. Man. 358 (in part as to the Colorado specimens). 1885.

Stems slender, 3–5 dm. high, terete or slightly flattened; leaves 1–3 dm. long, slightly flattened laterally or nearly terete, 1–2 mm. in diameter, septate; sheaths with scarious margins which end in rounded auricles, which are 1–1.5 mm. wide; bract 1–3 cm. long, lanceolate or subulate, brown with green back; inflorescence open, 2–5 cm. long, irregularly cymose with 4–10 heads; bractlets ovate, brown, acuminate-cuspidate; heads 6–9 mm. in diameter, 5–10-flowered; petals and sepals lanceolate, dark brown, about 3 mm. long, acuminate, longer than the capsule which at maturity is truncate or slightly emarginate at the apex: seeds not caudate.

*Unless otherwise stated the types are preserved in the herbarium of the New York Botanical Garden.

This species is most nearly related to *J. nevadensis*, *J. Mertensianus* and *J. Richardsonianus*, with which three it has been confused. It differs from the first in the truncate capsule, from the second in the paniculate inflorescence and not caudate seeds, and from the last in the dark acuminate petals and sepals and the short capsule. It grows in wet meadows at an altitude of 1800–2700 m.

COLORADO: Meadow Height, 1898, *Shear & Bessey, 4323* (type); Elk River, Routt County, 1894, *C. S. Crandall.*

WYOMING: Copperton, 1901, *F. Tweedy, 4335;* North Fork of Clear Creek, Big Horn Mountains, 1898, *T. A. Williams;* Grand Encampment Creek, 1897, *Aven Nelson, 3981.*

Juncus brunnescens sp. nov.

Juncus xiphioides montanus Engelm. Trans. Acad. Sci. St Louis, **2**: 481 (in part). 1868.

Stem 4–6 dm. high, flattened laterally and more or less winged; leaves 1–2.5 dm. long, 2–5 mm. wide, equitant, laterally flattened, long-attenuate, septate; sheaths with scarious margins, abruptly contracted above, but scarcely auricled; bract linear-lanceolate, 2–5 cm. long, green; panicle open, 5–10 cm. long, with from 10–60 small heads; bractlets ovate-lanceolate or ovate, abruptly acuminate, scarious and light brown; heads 5–12-flowered; petals and sepals subequal, lanceolate, acuminate, about 3 mm. long, light brown with green midrib; stamens usually 6, sometimes 4 or 5; style about equaling the petals; capsule lance-ovoid acute.

This was included in *J. xiphioides montanus* by Engelmann, but the first specimen cited by him belongs to a distinct plant with few, large, dark brown heads. This has received the name *J. saximontanus* by Aven Nelson. Besides the character mentioned, the scarious margins of the leaf-sheaths in the latter nearly always end in small auricles, a character by which it differs from all the species of the group. *J. brunnescens* grows in wet places in the mountains of Colorado, New Mexico and Arizona, while *J. saximontanus* ranges from Alberta and British Columbia to Colorado and California.

COLORADO: Pagosa Springs, 1899, *C. F. Baker, 245* (type).

NEW MEXICO: Bear Mountain and Mangus Springs, *Rusby, 417 C, 417 D* and *417 F.*

ARIZONA: Flagstaff, 1898, *MacDougal, 304;* San Pedro Val-

ley, *J. W. Toumey, 6;* Fort Verde, *E. A. Mearns;* San Francisco Mountains and Clifton, *Rusby, 417 A* and *417 E.*

Juncus parous sp. nov.

Stem 3–6 dm. high, laterally flattened and distinctly winged; leaves equitant, laterally flattened, septate, 2–3 dm. long, 3–5 mm. wide; sheaths with scarious margins that taper upwards and without any indication of an auricle; bracts 1–2 cm. long, green with more or less scarious margins; heads few, 1–8, often clustered, 15–20-flowered; bractlets lanceolate, light brown; petals and sepals lanceolate, sharply acuminate, subequal, light brown or greenish on the back; stamens usually 6; style shorter than the petals; capsule oblong, acute, shorter than the petals; seeds apiculate.

This is still more closely related to *J. saximontanus* than the former, but is easily distinguished by the light-colored heads and the total lack of auricles. It grows in mountain meadows of Colorado and New Mexico.

COLORADO: Fort Garland, 1896, *C. L. Shear, 3666* (type) and *3668;* North Cheyenne Cañon, 1896, and Pike's Peak, 1895, *E. A. Bessey.*

NEW MEXICO: Organ Mountains, 1897, *E. O. Wooton, 615.*

Juncoides subcapitatum sp. nov.

Stem 3–4 dm. high, glabrous; leaf-blades lanceolate, acuminate, glabrous, 4–10 cm. long, 5–10 mm. wide; bracts 2.5–3 cm. long, lanceolate, foliaceous; inflorescence compact, consisting of 6–10 heads, conglomerate and forming an irregular head; bractlets ovate, those subtending the individual flowers about half as long as the sepals; these and the petals subequal, 1.5–2 mm. long, ovate, acuminate, dark brown but lighter on the midrib; capsule broadly obovoid, obtuse, shorter than the petals; seeds about 1 mm. long, ellipsoid, obtuse, dark brown, minutely punctate.

Notwithstanding the capitate inflorescence, the large foliaceous bracts, and the shorter capsule, it is most closely related to *J. parviflorum,* which it resembles in leaves and flowers. The type grew near timber-line on a mountain above Silver Plume.

COLORADO: Silver Plume, 1895, *C. L. Shear, 4611.*

Allium macropetalum sp. nov.

Bulb obovoid, about 4 cm. long and 2 cm. thick, coated with long loose fibers; leaves about 2 cm. long, almost equaling the

scapes, 2–4 mm. wide; sheaths very broad, loose and scarious; scapes a little over 2 dm. high, stout, 3–4 mm. thick, often 2 or 3 from the same set of sheaths: umbel many-flowered; bracts usually 3, ovate-lanceolate, acuminate, about 2 cm. long, veined with purple; pedicels stout, about 2 cm. long; the outer in fruit spreading or reflexed; petals and sepals lanceolate, long-attenuate, fully 1 cm. long, white, scarious, with a prominent purple midvein; capsule 5–6 mm. long, with 6 conspicuous oblong crests which are over 1.5 mm. high.

This species is perhaps most nearly related to *A. Geyeri*, but stouter, usually with 2 or 3 scapes, loose sheaths, longer and more attenuate petals and sepals, larger conspicuous crests, and longer bulb with very fibrous coat.

COLORADO: May 14, 1898, *C. S. Crandall.*

Allium Pikeanum sp. nov.

Bulb obliquely ovoid, about 1.5 cm. long and 8–10 cm. thick; coat membranous except the outer layer, which is fibrous-reticulated; scape 8–15 cm. long, almost equaled by the narrowly linear leaves: bracts usually 3, lanceolate, 8–10 mm. long and very soon reflexed; umbels with 10–15 flowers, but no bulblets; pedicels about 1 cm. long; petals and sepals subequal, ovate, acuminate, red-purple; filaments subulate, dilated below, about three-fourths as long as the petals; capsule slightly crested above.

This is most nearly related to *A. reticulatum* and *A. Geyeri*, but distinguished by the small reflexed bracts, the dark flowers and the small bulb with only the outermost layers of the coat fibrous. It grows in the higher mountains of the Pike's Peak region at an altitude of 3,000–3,800 m., while the other species mentioned belong to the plains.

COLORADO: Halfway House, 1896, *C. L. Shear, 3721* (type); South of Pike's Peak and Bald Mountain, 1895 and 1896, *E. A. Bessey;* Peak Valley, 1901, *Clements, 426.*

Corallorrhiza ochroleuca sp. nov.

Whole plant light yellow; stem 2–4 dm. high, not bulbous-thickened at the base; sheaths loose and rounded and mucronate at the apex; raceme 10–15-flowered; flowers 15–20 mm. long, light yellow, unspotted; petals and sepals 7–8 mm. long, oblong-lanceolate, acute, with prominent midvein; lip ovate, sinuate but neither lobed nor toothed; spur small and adnate to the ovary.

In general habit, this resembles a large *C. multiflora*, but dif-

fers in the yellow color of the plant, the unspotted flowers and the entire lip. It grows at an altitude of 1400–2500 m.

NEBRASKA: War Bonnet Cañon, 1890, *T. A. Williams, 48* (type).

COLORADO: Echo Cañon, near La Veta, 1900, *F. K. Vreeland, 649.*

Salix pachnophora sp. nov.

A shrub 2–3 m. high or perhaps sometimes higher: stems yellowish; branches dark bluish with a bloom; leaves oblong-lanceolate or oblanceolate, 3–5 cm. long, or on vigorous shoots 1 dm. long, acute at both ends, densely white-silky beneath, glabrous or when young slightly silky above, rather thin, with prominent veins beneath; pistillate aments subsessile, 1–3 cm. long; bracts almost black, ovate or oblong, acutish or obtuse; pistils subsessile; ovary grayish-silky, ovoid, 3–5 mm. long; styles slender, about 1.5 mm. long; stigmas slender, deeply 2-cleft; staminate aments about 1.5 mm. long, subsessile; bracts similar; stamens 2, filaments glabrous, distinct.

This species is evidently mo st nearly related to *S. bella* and *S. subcoerula*, differing from the former in the smaller aments and capsules and the presence of bloom on the branches and from the latter by the sessile and naked aments. It grows in the mountains at an altitude of 2,300 to 2,500 m.

COLORADO: Chambers lake, 1899, *Agricultural College of Colorado* coll. (type); Rico, Dolores Co., 1899, *Geo. E. Osterhout, 2505;* along Uncompahgre River near Ouray, 1901, *Underwood & Selby, 256.*

NEW MEXICO: Beulah, 1901 & 1902, *T. D. A. Cockerell.*

Atriplex oblanceolata sp. nov.

Suffruticose dioecious perennial with decumbent base and ascending branches, about 2 dm. high; leaves oblanceolate or spatulate, 2–3 cm. long, obtuse or acutish, densely white-scurfy on both sides, entire, short petioled, or sometimes nearly sessile; pistillate flowers in small axillary clusters; fruiting bracts ovate in outline, slightly dentate, tubercled or irregularly crested on the back; staminate flowers brown in small terminal panicles.

This species is most nearly related to *A. Nuttallii* and *A. eremicola.* From the former it differs in the decumbent low habit, the more distinctly petioled leaves and the brown panicled staminate flowers (in *A. Nuttallii* they are yellow and arranged in interrupted spikes). It is more like *A. eremicola*, from which it scarcely differs except

in the tubercled or appendaged bracts, which are broadest below instead of above the middle.

COLORADO: Delta, Sept. 3, 1897, *J. H. Cowen* (Agric. Coll. Colo., *no. 4071*) (type), Hotchkiss and Smiths Fork (*no. 4070*).

WYOMING: Gardiner River, 1899, *Aven & Elias Nelson, 5995*; Hams Fork, 1900, *C. C. Curtis*; Fort Steele, 1901, *Tweedy, 4501*.

Atriplex odontoptera sp. nov.

A shrubby dioecious perennial: stems with shining white more or less flaky bark; leaves narrowly oblanceolate, acute or obtusish, 2–4 cm. long, entire, white-scurfy on both sides; pistillate flowers axillary; fruiting bracts united to near the apex; united portion with 4 laciniate dentate wings, 3–4 mm. broad, reticulate and ribbed; free portion subulate, scarcely as long as the width of the wing; staminate plant unknown.

This species is most nearly related to *A. canescens*, differing mainly in the laciniate-toothed wings. It grows on plains at an altitude of 1,000–1,600 m.

WYOMING: Buffalo, 1900, *F. Tweedy, 3302* (type); four miles below U. L. Ranch, 1896, *Knowlton, 160*; Steamboat Lake, 1900, *Osterhout, 2330*, in part.

Coriospermum emarginatum sp. nov.

Annual, perfectly glabrous or with a few hairs on the bracts, branched near the base, 3–4 dm. high: leaves narrowly linear, 2–4 cm. long, 1–2 mm. wide, cuspidate-pointed; bracts except the lowest ovate, 5–7 mm. long, acuminate, scarious-margined, much broader than the fruit; fruit plano-convex, 2.5–3 mm. long and about 2 mm. wide, almost without a trace of a wing-margin.

In habit this species resembles mostly *C. marginale*, but differs in the lack of the wing-margins of the fruit characteristic of that species. In this respect it more resembles *C. villosum*, but is a much more slender plant and glabrous.

WYOMING: Laramie, 1897, *A. Nelson, 4282* (type).

COLORADO: A specimen in the Torrey herbarium without any other data.

Claytonia rosea sp. nov.

Scape about 1 dm. high, slender, from a small corm 10–15 mm. in diameter; basal leaves rare, long-petioled; blade 1–2 cm. long, spatulate; stem-leaves linear or narrowly linear-lanceolate, sessile, 2–5 cm. long, 1-ribbed or faintly 3-ribbed, acute, rather fleshy;

sepals rounded ovate, rounded at the apex, about 5 mm. long, half as long as the pink obovate petals; inflorescence 5–10-flowered, short, little exceeding the leaves, bractlets lanceolate; capsule shorter than the sepals; seeds about 2 mm. long, black and very glossy.

The few specimens of this species that are found in our herbaria bear a variety of names, as *C. caroliniana*, *C. caroliniana lanceolata*, *C. caroliniana sessilifolia* and *C. lanceolata sessilifolia*. The original *C. lanceolata* Pursh is a much larger plant with broad, strongly 3-ribbed stem-leaves, elongated inflorescence and large flowers, the sepals being about 6 mm. long. The type of *C. caroliniana sessilifolia* Torr., is a plant somewhat resembling the present species, but with somewhat broader leaves abruptly contracted at the sessile base and with acutish sepals. Neither in the herbarium of the New York Botanical Garden nor in that of Columbia University is found any other specimen matching the original collected by Bigelow. Most species of *Claytonia* are found near water or in damp places. The type of *C. rosea* was collected on rather dry hills, at an altitude of 2200–2300 m.

COLORADO: La Veta, 1900, *Rydberg & Vreeland, 6300* (type); "Colorado," *G. C. Woolson;* 1875, *W. A. Henry;* Graham's Peak, 1899, *C. F. Baker, 305.*

WYOMING: Pole Creek, 1894, *Aven Nelson, 27.*

Cerastium pulchellum sp. nov.

Low decumbent perennial with horizontal cespitose rootstock: stems 5–10 cm. long, finely viscid pubescent; leaves oblong to oval, obtuse or rarely acutish, about 1 cm. long and 4 mm. wide, subsessile and slightly connate at the base, viscid pubescent on both sides; peduncles 1–1.5 cm. long; inner sepals oblong; outer oval, scarious-margined both on the side and at the rounded apex, about 4 mm. long; petals obcordate, 10–12 mm. long.

This species is nearest related to *C. Earlei* and *C. behringianum*. From the former it differs in the low habit, the very obtuse scarious-tipped sepals and the short blunt leaves; from the latter in the large petals and the scarious-tipped sepals. It grows in the mountains at an altitude of about 3900 m.

COLORADO: Hayden Peak, 1898, *Baker, Earle & Tracy, 573.*

Arenaria polycaulos sp. nov.

Arenaria saxosa Coult. Man. 35, 1885, and Gray, Syn. Fl. 1[1]: 240, in part; not A. Gray, Pl. Wright. 2: 18.

Perennial with a long tap-root, giving rise to numerous prostrate or spreading stems about 1 dm. long, slender, finely scabrous puberulent; leaves ovate or ovate lanceolate, spreading, about 5 mm. long, finely puberulent; pedicels 5–10 mm. long; sepals ovate-lanceolate, short-acuminate, scarious-margined, 3–4 mm. long; petals 5–6 mm. long, obovate, entire.

This plant has generally been known as *A. saxosa*, but the type collected by Wright differs considerably from it, being subligneous at the base, with short erect stems, lanceolate almost erect leaves and narrower sepals. *A. polycaulos* grows on dry hills at an altitude of 2600–3000 m.

COLORADO: Silverton, 1898 (type; collector not given, but specimens received from the Agricultural College of Colorado); 1895, *Tweedy, 173;* Mt. Harvard, 1896, *F. E. Clements, 54;* Gray Back Mining Camps, 1900, *Rydberg & Vreeland, 6288;* La Plata P. O., 1898, *Baker, Earle & Tracy, 444;* Dark Cañon, 1901, *Clements, 115;* Breckenridge, 1896, *Shear, 4558* and *4545*.

ARIZONA: Mt. Humphrey, 1883, *Rusby, 531;* 1897, *R. E. Kunzé;* San Francisco Mts., 1892, *Toumey, 487*.

Arenaria Tweedyi sp. nov.

Perennial, densely cespitose with somewhat ligneous base; leaves fleshy, linear-filiform, 2–3 cm. long, less than 1 mm. wide, somewhat curved; stem usually less than 1 dm. high, glandular puberulent especially on the inflorescence; this an open cyme; bracts lanceolate, scarious-margined; pedicels about 1 cm. long; sepals lanceolate, acute, about 5 mm. long, scarious-margined and decidedly glandular puberulent; petals about 8 mm. long.

This is most nearly related to *A. uintahensis* A. Nelson, differing in the fleshy not pungent leaves and the more glandular puberulent inflorescence. It grows in the mountains at an altitude of about 3600 m.

COLORADO: La Plata Mountains, 1896, *Frank Tweedy*.

Arenaria Eastwoodiae sp. nov.

Perennial with a cespitose base; stems about 2 dm. high, perfectly glabrous; leaves filiform, stiff, pungent, 1–2 cm. long, 0.5 mm. wide, minutely scabrous-ciliolate on the margin below, dilated

and somewhat connate at the base; inflorescence elongated; bracts subulate to lanceolate, scarious-margined; pedicels erect, 1–2 cm. long, glabrous; sepals linear-lanceolate, about 6 mm. long, glabrous, long-attenuate, equalling or slightly exceeding the petals.

This is most nearly related to *A. Fendleri* but is more slender and glabrous. It grows on dry hills.

COLORADO: Grand Junction, 1892, *Alice Eastwood.*

Arenaria Fendleri Porteri var. nov.

Like the type but low, 1–2 dm. high, very glandular; leaves short; branches of the inflorescence short and ascending.

It is common on dry mountain ridges of Colorado. As type I take the following:

COLORADO: Gray's Peak, 1878, *M. E. Jones, 716* (type in herb. Columbia University).

Alsinopsis macrantha sp. nov.

Perennial, cespitose, diffusely branched and spreading, perfectly glabrous; branches 1 dm. long or less; leaves subulate-filiform, obtuse, 5–10 mm. long, 0.5 mm. wide, 1-nerved; pedicels 1 cm. or less long; sepals lanceolate, 4–5 mm. long, very acute, scarious-margined, strongly 3-nerved; petals oblong, 7–8 mm. long.

The type sheet is labelled *Arenaria verna* L., which it resembles much in habit, in the sepals and in the lack of pubescence, but it differs in the large petals and the 1-nerved leaves.

COLORADO: Little Kate Basin, La Plata Mts., 1898, *Baker, Earle & Tracy, 678.*

Silene Antirrhina vaccarifolia var. nov.

Stem-leaves broad, lanceolate, elliptic or oblanceolate; stem stouter than in *S. Antirrhina* proper; bracts more or less scarious-margined below; flowers and capsule larger.

In the Rocky Mountain region the typical *S. Antirrhina* is rather rare and evidently an introduced plant found in waste places and fields. It is there represented by two native forms, the present with broad leaves and large flowers and the next with narrow leaves and small flowers.

IDAHO: Lewiston, 1896, *A. A. & E. Gertrude Heller, 3153* (type in herb. Columbia University); Upper Ferry, Clearwater River, 1892, *Sandberg, MacDougal & Heller, 190.*

MONTANA: Big Horn River, 1891, *Tweedy*.

COLORADO: Foothills, Larimer County, 1895, *J. H. Cowen, 82*; near Golden, 1878, *M. E. Jones, 279*; Rist Cañon, 1897, *J. H. Cowen*.

Silene Antirrhina depauperata var. nov.

Like the species but more slender and few-flowered; calyx in fruit very short; petals none or small, not exceeding the calyx-lobes; blade cuneate, truncate or emarginate at the apex.

BRITISH COLUMBIA: Lower Arrow Lake, 1890, *J. M. Macoun* (type).

COLORADO: 1874, *G. C. Woolson*.

ARIZONA: Tucson, 1894, *J. W. Toumey*.

SOUTH DAKOTA: Lead City, 1892, *P. A. Rydberg, 557*.

WASHINGTON: W. Klickitat County, 1891, *W. N. Suksdorf*.

WYOMING: Hartville, 1892, *Aven Nelson, 493*.

NEBRASKA: Dismal River, 1893, *P. A. Rydberg, 1349*.

UTAH: City Creek Cañon, 1880, *M. E. Jones, 1839*.

Lychnis striata sp. nov.

Perennial with more or less cespitose base; stems 3–5 dm. high, finely puberulent and more or less viscid above; basal leaves and lower stem-leaves narrowly oblanceolate, 5–15 cm. long with a more or less distinct petiole; upper stem-leaves sessile and linear-lanceolate; inflorescence narrow with erect branches; calyx densely viscid puberulent, strongly 10-nerved, in fruit somewhat extended by the capsule, 10–12 mm. long and 5 mm. wide; its lobes oblong, obtuse, somewhat scarious-margined; petals exserted, about 15 mm. long; claw long, narrowly cuneate, fully equaling the calyx; blade short, two-cleft, with obtuse lobes.

This species is most nearly related to *L. Drummondii*, but differs in the exserted petals and the more strongly 10-nerved calyx. It grows at an altitude of 2000–3300 m.

COLORADO: Cameron Pass, 1896, *C. F. Baker* (type), also 1899; Silver Plume, 1895, *P. A. Rydberg*.

WYOMING: Battle, 1901, *Tweedy, 4535*, also Headwaters of Tongue River, 1898, *163*; Yellowstone Lake, 1899, *Aven & Elias Nelson, 6634*.

UTAH: Evanston, 1869, *S. Watson, 154*.

Atragene pseudo-alpina diversiloba var. nov.

A peculiar form with merely ternate leaves, the segments of which are more or less cleft or lobed, some rounded at the apex; staminodia conspicuous, spatulate or oblanceolate.

This may be a distinct species, but the material is too scant. The most striking character is the conspicuous staminodia, which in the species are narrowly linear or more often lacking.

COLORADO: Mountains near Denver, 1869, *B. H. Smith* (type herb. Columbia University).

Stanleya glauca sp. nov.

Tall, perfectly glabrous, 4–6 dm. high, bluish green; lower leaves 1–1.5 dm. long, more or less pinnatifid with linear-lanceolate or oblong lobes, the terminal usually much longer than the rest; upper leaves usually entire, linear-lanceolate; racemes 3–4 dm. long, sometimes branched below; sepals and petals lemon-yellow; the former oblong, about 1 cm. long, deciduous; petals of about the same length, long-clawed; claws more or less pubescent, about twice as long as the oblong blades; fruiting pedicels about 1 cm. long, more or less spreading; stipes about 1.5 cm., slender; pod proper about 5 cm. long and 1.5 mm. thick, somewhat arcuate, but neither tortuose nor torulose; seeds oblong, dark brown, minutely pitted.

This species is perhaps most nearly related to *S. integrifolia* James, which, however, differs in the following respects: the stem lower, leaves thicker and broader, oval or broadly oblanceolate; the lower, if lobed, with broad and short lobes; claws of the petals broader at the base, shorter, scarcely longer than the oblong spatulate blades. *S. glauca* grows on the dry hills and table lands at an altitude of 1,200–2,500 m.

COLORADO: Prairie, Entrance Soldier's Cañon to Sulphur Springs, 1895, *J. H. Cowen* (type); McElma Cañon, 1901, *F. K. Vreeland, 871;* plains near Fort Collins, 1896, *C. S. Crandall;* near Badita, 1900, *Rydberg & Vreeland, 6120;* Dixon Cañon, 1899, *W. F. M.;* Mancos, 1898, *Baker, Earle & Tracy, 412;* Pueblo, *10;* Garden of the Gods, 1894, *E. A. Bessey;* Pike's Peak, 1894, *T. F. Allen.*

Schoenocrambe decumbens sp. nov.

Stem slender, decumbent, 2–3 dm. long, as well as the whole plant perfectly glabrous, more or less branched; leaves narrowly

linear, 2–6 cm. long, 1–3 mm. wide, 1-nerved, rather thick and more or less glaucous; raceme rather few-flowered, lax; pedicels 3–5 mm. long, ascending; sepals oblong, about 4 mm. long, light yellow; petals yellow, 6–7 mm. long, spatulate or oblanceolate, obtuse, gradually narrowed into a more or less distinct claw; pods 3–4 cm. long, about 0.75 mm. in diameter, usually more or less arcuate, beak (*i. e.*, portion above the end of the valves) about 1 mm. long.

This species is closely related to *S. linifolium*, but differs in the more slender and more branched decumbent stem, usually narrower leaves, smaller flowers, and more slender pods, which are more or less arcuate and with a more distinct beak. It grows on dry plains and hills.

MONTANA: Melrose, 1895, *P. A. Rydberg, 2671* (type); Sheridan, 1895, *L. A. Fitch.*

UTAH: Thistle Junction, 1900, *S. G. Stokes.*

COLORADO: Gypsum, 1894, *C. S. Crandall.*

NEW YORK BOTANICAL GARDEN.

INDEX TO AMERICAN BOTANICAL LITERATURE

(1904)

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in its broadest sense.

Reviews, and papers which relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omission their kindness will be appreciated.

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